

CAPTAIN COOK GRAVING DOCK

NOMINATION FOR ENGINEERING HERITAGE

NATIONAL RECOGNITION

October 2019

Application by Naval Historical Society of Australia



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Appendix 3

M.W.Mehaffey, BE (NZ). *Captain Cook Graving Dock, Sydney – General Story of Construction*. The Journal, December, 1951. The Institution of Engineers, Australia.

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J.P. Shields. *Captain Cook Graving Dock, Sydney – The Building of the Floating Caissons*. The Journal, March, 1952. The Institution of Engineers, Australia.

Appendix 5

C.R. Bickford. *Captain Cook Graving Dock, Sydney – Fitting-out Wharf of Reinforced Concrete, 250-ton Crane Foundations, and Docking Blocks*. The Journal, March, 1952. The Institution of Engineers, Australia

Appendix 6

W. Hudson, B.Sc.(Eng) and D.G.Bruce. *Captain Cook Graving Dock, Sydney – De-watering, Excavations, Concrete Work and Backfilling*. The Journal, March, 1952. The Institution of Engineers, Australia

1 INTRODUCTION

The 24th of March 2020 will be the 75th Anniversary of the Opening of the Captain Cook Dock at Garden Island in Sydney Harbour.

Construction of the Captain Cook Dock commenced in 1940 and was completed in March 1945.

The construction of the Captain Cook Dock was the largest engineering feat of its day, undertaken under wartime conditions and it was the largest and most complex engineering project in Australia until the construction of Guthega Power station in 1958.

The dock was designed to take the largest ship of the day with scope for expansion.

The statistics and photographic records for the construction of dock give the prodigious scale of all aspects of its construction. Post war engineering papers prepared by those responsible for design and construction gave the full technical details for the dock and all the efforts to bring this project into being at the earliest possible time.

The statistics for the dock construction are staggering and include:-

Dredging – 150,000 cu yards of silt

Rock/clay/sand required – 800,000 cu yards

Sheet piling – 170,000 feet

Concrete poured – 330,000 cu yards

Manpower : 4125 men at peak construction activity

The dock has been in continual use since the first docking of the aircraft carrier HMS Illustrious that occurred on 2nd March 1945, three weeks prior to the official opening.

The Official Opening occurred took place on 24th March 1945 and was conducted by the Governor General of Australia.

The Opening was clouded in controversy. The workers boycotted the event. The unions representing Dockyard workers and the men of the civil Constructional Corps (who legally could not strike) , totally some 6500 men, initiated the boycott over the quality of the individual workers invitations (no gilt edging) and the segregation of the workers and wives away from the official party.

Since the opening, the dock has serviced hundreds of Naval and merchant ships of all sizes.

The dock remains a vital national asset providing dry docking facilities for the Royal Australian Navy and for commercial shipping.

The Garden Island Defence Precinct is undergoing major works including replacement of aging services. These works are being undertaken under Stage Two of the Garden Island (East) Critical Infrastructure Recovery Program.

https://www.aph.gov.au/Parliamentary_Business/Committees/Joint/Public_Works/GardenIslandCritInfras

The Captain Cook Graving Dock is one of the largest dry docks in the southern hemisphere and the only one in Australia capable to meet the needs of both naval and commercial shipping. It is an asset of national significance that continues to serve the Navy and the Nation.

2 NOMINATION LETTER

Learned Society Advisor
Engineering Heritage Australia Engineers Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Name of work:

Captain Cook Graving Dock

This work is nominated for an *Engineering Heritage National Marker* award under the Heritage Recognition Program of Engineers Australia.

Location, including address and map grid reference if a fixed work: *Garden Island Defence Precinct, Sydney*

Owner (name & address):

*Commonwealth of Australia
HMAS Kuttabul*

The owner has been advised of this nomination and a letter of agreement is attached.

Access to site: While within the secure area of the Garden Island defence Precinct to enable the public to view the docks and its operation, the Naval Historical Society of Australia(NHSA) has for more than thirty years conducted weekly Heritage Tours of Garden Island that has enabled the public to view and understand this huge and complex engineering undertaking and the continuing significance of the Dock. Go to www.navyhistory.org.au and Garden Island Tours.

Nominating Body:

*Naval Historical Society of Australia
David Michael, President
(Authorised representative of nominating body)*

Date:

.....
Chair (*Divisional heritage group*)
Date:

.....

3 LETTER OF AGREEMENT FOR NOMINATION

4 HERITAGE ASSESSMENT

4.1 Basic Data

Name: Captain Cook Graving Dock

Location: Garden Island Defence Precinct, Sydney

State: NSW

Local Government Area: Sydney City Council

Owner: Commonwealth of Australia, Royal Australian Navy, HMAS Kuttabul

Current use: Dry dock operated by Thales

Former use: Dry dock that has been in continuous use since 2nd March 1945

Designer: John Guthrie Brown M.I.C.E., principal consultant, Sir Alexander Gibbs and Partners. The whole of the design was under his control.

Maker/Builder:

Mr M.W. Mehaffey BE AMICE , Assistant Director-General, Department of the Interior and Chief of the Dock Construction Section was in charge of all construction work, Mr James Muir being his deputy.

The work was undertaken by various Departments and instrumentalities of the State of New South Wales

Metropolitan Water Sewerage and Drainage Board – dealt with the majority of the constructional work including the de-watering of the coffer dam, the execution of the dock itself, the pump-house, the East and West wharves and the various ancillary works

Public Works Department of New South Wales – provided the stone filling for the cofferdams

Maritime Services Board of New South Wales -responsible for the erection of the cofferdam, the dredging and construction of the fitting -out wharf, the removal of the temporary portion of the cofferdam on completion, and the provision and fixing of the docking blocks

Sydney County Council Electric Undertaking -responsible for the supply of power and the testing and coordination of switchgear and for installation of certain substations

Sydney City Council – execution of roads

New South Wales State Railways- dealt with the internal railway system for delivery of concrete and materiel

Main Contractors included:-

Gwynne's Pumps Ltd.

Glenfield & Kennedy Ltd.

General Electric Co. Ltd

Stohert & Pitt Ltd

Sir William Arrol & Co. Ltd

The Sydney Steel Co. Pty Ltd

The Southern Portland Cement Co. Ltd

Commonwealth Portland Cement Co. Ltd.

Hutcherson Bros.

W. A. Hodgkinson & Co. Pty Ltd

Loveridge & Hudson Pty Ltd

Blue Metal & Gravel Pty Ltd

Australian Blue Metal Co.

Broken Hill Pty Co Ltd

Westinghouse Roseberry Pty Ltd

Slazengers(Australia) Pty Ltd

Year Started: 1940

Year Completed: 1945

Physical Description: Concrete dry dock 345m long, 45 m wide and 14m deep

Physical Condition: Operating condition

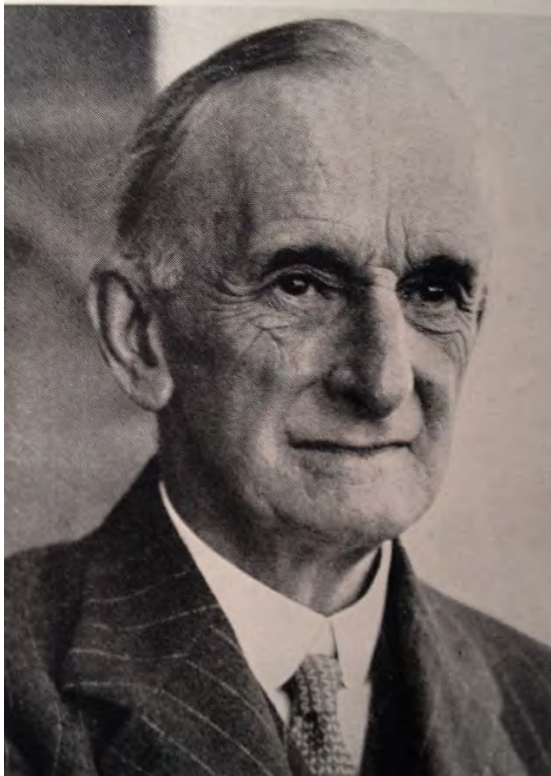
Modifications and Dates: Only minor modifications to the dock since 1945.

3.2 History

The need for a naval graving dock in Australia became crucial with the deteriorating world situation in the 1930s. There was little doubt that Australia's security would depend upon its commercial sea lanes. The country's ability to maintain the rate at which its naval forces could be repaired and returned to sea would play a large part in its ultimate survival.

In 1938 the Cabinet responded to this situation by approving, in principle, the construction of an Australian naval graving dock. The Australian Government approached the British Admiralty with its assessment of the requirement and asked for its assistance. As a result Sir Leopold Savile KCB, past President of the Institution of Engineers, a senior principal in the British engineering firm Sir Alexander Gibb and Partners, was invited to Australia to investigate and report on the most suitable

[illegible]



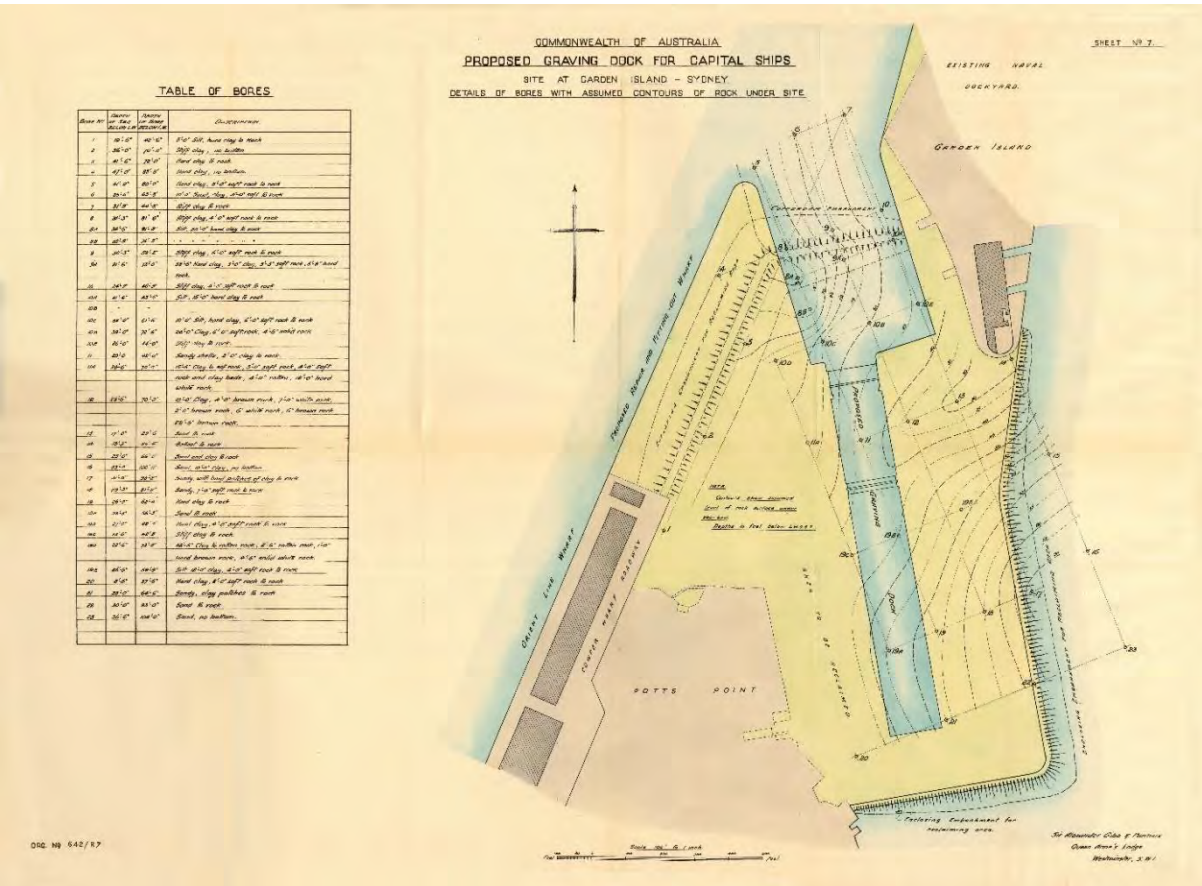
Sir Leopold H. Saville K.C.B

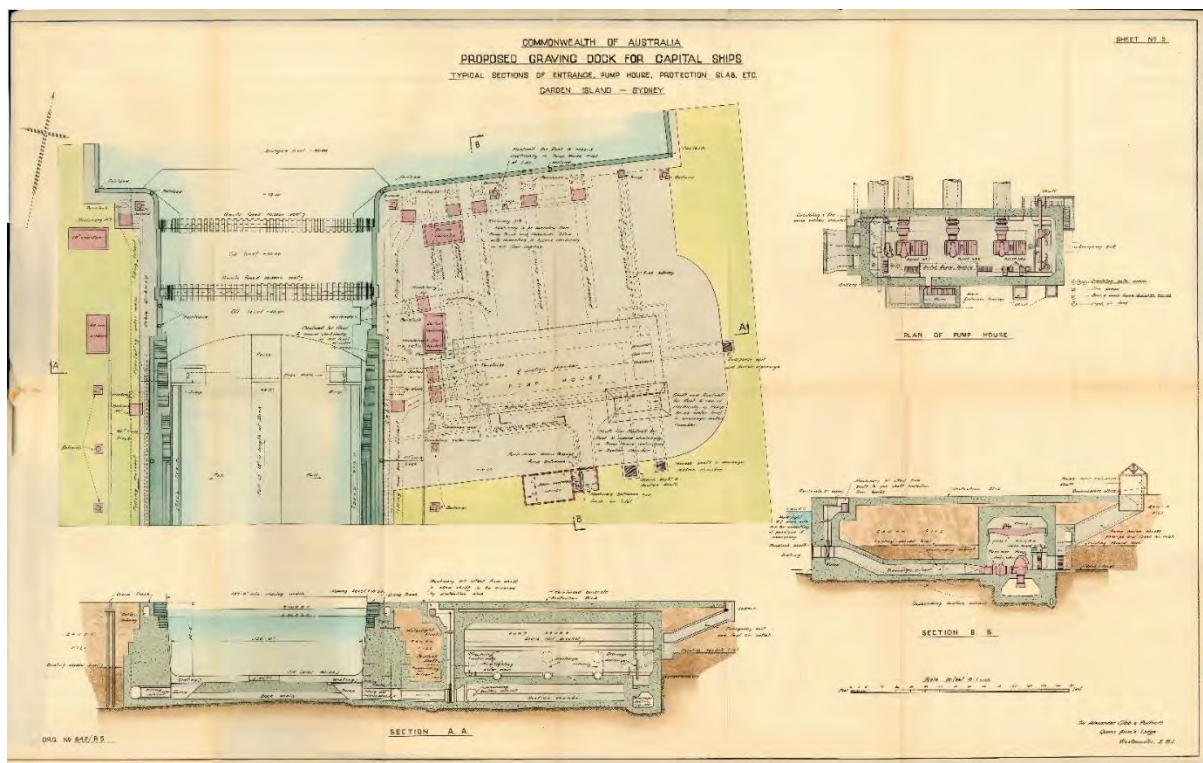
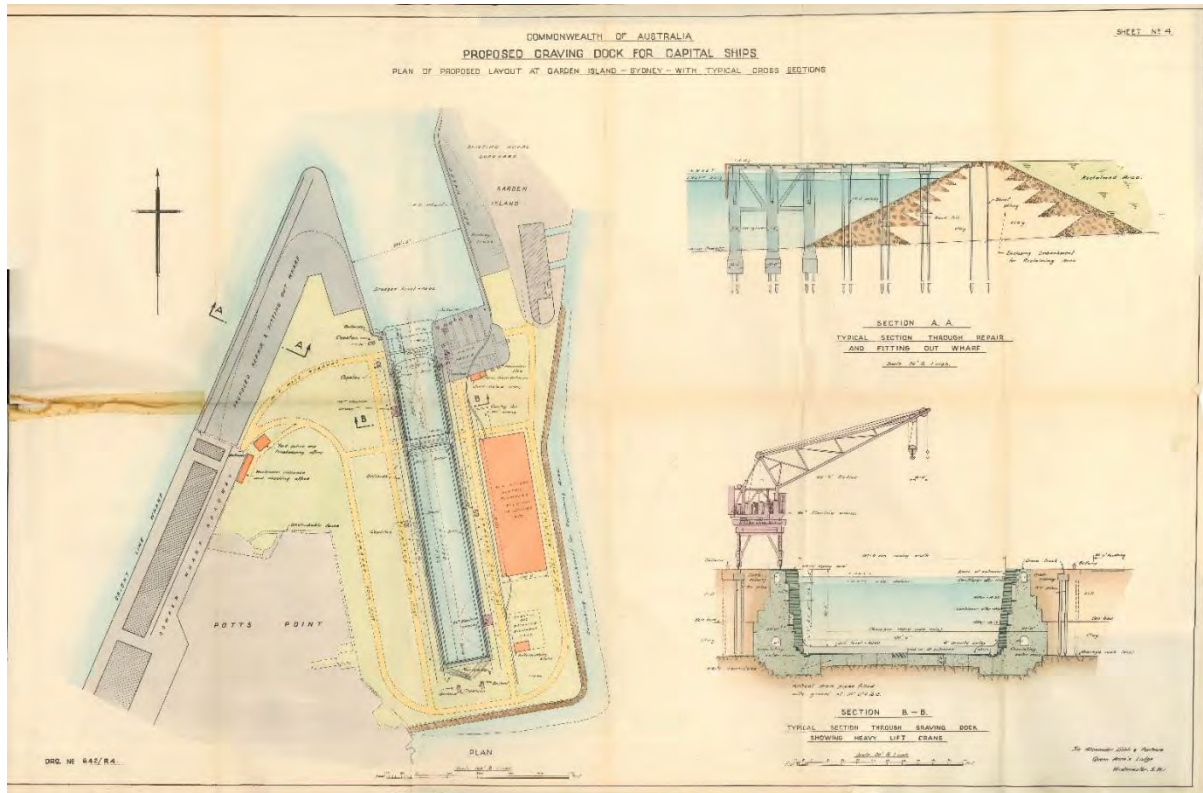
He was to consider the strategic as well as the engineering aspects of the sites and was reminded that the dock would also need to be used for repairing large merchantmen acting as troop ships. After completing his investigation, Saville concluded that three sites would fulfil these requirements. One was at Adelaide while the other two were in Sydney Harbour. Construction of the graving dock between Garden Island and the foreshore would best fulfil all the requirements. It was already well protected, provided easy entry for the fleet, and would enhance the importance of the existing Garden Island Naval Depot. In a report dated 31 January 1940, Sir Alexander Gibbs and Partners advised the adoption of the Garden Island-Potts Point proposal.

The Prime Minister, Mr. R. G. Menzies, told the Parliament on 1 May, 1940: *'A dry dock of a larger size than any in Australia has been an important strategic consideration since the size of capital ships has increased so greatly. I do not need to elaborate the great value to Australia of a dock capable of accommodating not only the largest warships but also merchant ships of great tonnage. The possession of such a dock would make Australia a fit base for a powerful fleet and would, in certain contingencies, enable naval operations to be conducted in Australian waters without the necessity for ships to travel 4,000 miles to Singapore for purposes of refit and repair. It is estimated that three years will be occupied in the construction of the dock. The estimated cost of the dock on the selected site is, in Australian currency, £2,997,000 compared with £3,039,000 for the other Sydney site (above the Harbour Bridge), and £3,839,000 for the Adelaide site. The Government has decided to accept the recommendation, and the work will be put in hand at the earliest possible moment.'*

On 4 July 1940 the War Cabinet decided that although the project had been the responsibility of the Department of the Navy, the construction phase should be placed under the Department for the Interior, which established a Dock Construction Section under the Assistant Commonwealth Director-General of Works, W. M. Mehaffey. Close liaison would be maintained with the Admiralty and the firm of consultants, particularly Mr. Guthrie Brown who designed the dock. In addition to

the construction of the graving dock, new workshops and modern machinery would be provided on the island, together with construction of a repair wharf with a 250-ton crane.





4.3 Heritage Listings

The Captain Cook Graving Dock has Commonwealth Heritage Listing as an integral part of the Garden Island Defence Precinct

<https://www.environment.gov.au/heritage/places/commonwealth-heritage-list>



5 ASSESSMENT OF SIGNIFICANCE

5.1 Historical Significance

The Garden Island Naval Base had its origin from 1788 when only 16 days after the landing in Sydney Cove the Captain of HMS Sirius sent men ashore on the island to clear area for a ship's garden to provide corn and onions for the crew, thus since then it has been called Garden Island.

The Naval Base in Sydney was the centre for naval activities that then encompassed all of Australia.

The building of the Captain Cook Graving Dock involved:- engineering in quarrying; maritime works; civil engineering especially concrete formulation, mass concrete pours and accuracy for caisson slots; mechanical and electrical engineering for the pumps; naval architecture in the design and construction of the caissons to close the dock also the selection of special timber on the caissons to provide the sealing of the dock.

The different engineering discipline employed in the works included quarrying, marine engineering, civil engineering, electrical engineering, mechanical engineering and naval architecture.

The Captain Cook Graving Dock was built under wartime conditions. The major imperative was the surrender of Singapore to Japanese Forces on 15th February 1942 and the loss of the dry dock there.

The work started in 1941 was conducted on 24 hour basis and to enable this to take place floodlight towers were erected so that the work, especially the concrete pouring was continuous even at night. In spite of the recognition that there was a real threat of a submarine based aerial attack on Sydney the importance of the construction meant that the floodlights had to stay on.

The two reconnaissance flights by submarine based float planes over Sydney in February 1942 and then in May 1942 were aided by the floodlighting for construction of the dock. The subsequent attack on Sydney is directly linked to the construction of the dock.

To provide air raid protection to the workers tunnels were driven in late 1941 /early 1942 to house 2500 workers if bombing took place. The attack on Sydney by midget submarines on 31st May 1942 and the subsequent shelling of Sydney suburbs on 8th June 1942 clearly demonstrated the perils for those constructing the dock were real.

However the importance of the work was such that the floodlighting was not removed.

12 days before the official opening the dock in 1945 it was used for the urgent repair of an aircraft carrier HMS *Illustrious*. This ship, part of the British Pacific Fleet, was on its way to take part in the final assault on Japan.

In accordance with the criteria as detailed in ***Appendix F of Engineering Heritage Recognition Program Guidelines***:

Historical Significance

Shows evidence of significant human activity – **Agree**

Is associated with a significant activity or historical phase – **Agree**

Maintains or shows the continuity of a historical process or activity – **Agree**

Historic Individuals or Association

Is associated with a significant event, person, or group of persons – **Agree**

Creative or Technical Achievement

Is associated with, creative or technical innovation or achievement – **Agree**

Has landmark qualities – **Agree**

Research Potential

Has the potential to yield new or further substantial scientific and/or archaeological information – **Agree**

Social

Is important for its association with an identifiable group – **Agree (Civil Constructional Corps)**

Rarity

Demonstrates unusually accurate evidence of a significant human activity – **Agree**

Demonstrates designs or techniques of exceptional interest – **Agree**

Representativeness

Is a fine example of its type – **Agree**

Has the principal characteristics of an important class or group of items – **Agree**

Has the attributes typical of a particular way of life, philosophy, custom, significant process, design, technique or activity – **Agree**

Is part of a group which collectively illustrates a representative type – **Agree**

Is outstanding because of its setting, condition or size – **Agree**

Is outstanding because of its integrity or the esteem in which it is held - **Agree**

5.2 Historic Individuals or Association

Rear Admiral Alec Boughton Doyle RAN (1888–1984)



Alec Boughton Doyle was born on 5 October 1888 at his family's property, Invermien, near Scone, New South Wales, the youngest of five children of James Henry Doyle, grazier, and his wife Rebekah Doyle (née McDonald). Alec was educated at Scone Grammar School and at The King's School, Parramatta, where he excelled at sport and was school captain in 1907. At the University of Sydney he studied engineering and graduated in 1911 with a Bachelors degree in Mechanical and Electrical Engineering. He also took part in sports including boxing and rowing and played cricket and Rugby. He then went to England to gain further industry experience.

On 23 March 1912 Doyle was commissioned in the Royal Australian Navy. After training in Britain, he returned home in 1913 as an engineer lieutenant in the new battle-cruiser HMAS *Australia*. When World War I broke out in August 1914, he was engineer officer of the destroyer HMAS *Parramatta*. The ship sailed immediately to German New Guinea, then patrolled Southeast Asian waters. During the deployment Doyle became bored by inactivity and disdainful of his superiors' competence. He was senior engineer of the light cruiser HMAS *Encounter* (1917-18) and

As Doyle's career flourished he spent most of his time ashore in shipbuilding and repair installations. In December 1923 he became engineer commander at the refit and repair establishment on Garden Island, Sydney Harbour. Later he worked at Cockatoo Island Dockyard, where he was overseer for the building of the sea-plane carrier HMAS *Albatross*, in which he served as engineer officer during 1929. Having been fleet engineer officer in HMAS *Sydney* in 1925, he was squadron engineer officer in the new heavy cruisers HMA Ships *Australia* and *Canberra* in 1929-32. From 1933 he was engineer manager at Garden Island. He was promoted captain in 1934 and appointed as a Commander of the Order of the British Empire (CBE) in 1937. On the night of 31 May 1942, when Japanese midgeet submarines penetrated Sydney Harbour, he was awakened at his married quarter, on Garden Island,

by gunfire from the cruiser USS *Chicago*. A Japanese torpedo later ran aground, without exploding, on a small beach beneath the bedroom in which his wife remained sleeping.

In September 1942 Doyle was appointed to Navy Office, Melbourne, as Director of Engineering (Naval). Twelve months later he was promoted rear admiral and named Third Naval Member of the Naval Board and Chief of Construction.

He was responsible for RAN contributions in regards building of the Captain Cook Graving Dock.

He retired from the Navy on 5 October 1948.

In December 1950 he was appointed to a Commonwealth Government manpower allocation committee. The Institution of Engineers, Australia, awarded him the (Sir) Peter Nicol Russell medal in 1953. After he retired, Doyle's many projects included the family pastoral company, Dr Barnardo's Homes (Dr Barnardo's in Australia), the Royal Society of St George, and the Institution of Engineers, Australia. He served as chairman of the Scone branch of the Graziers' Association of New South Wales and delegate to the district council.

Rear Admiral Alec Doyle passed away on 30 June 1984.

Thomas Haynes Upton, *President Metropolitan Water Sewerage and Drainage Board*. Upton was a founding associate (1919) and member (1922) of the Institution of Engineers, Australia, Upton joined its board of examiners in 1932. Representing (1939-54) the Sydney division on the council, he was elected a vice-president in 1944 and president in 1946.



In February 1925 Upton was appointed to the statutory Main Roads Board in New South Wales. Shortly before moving to Sydney, he married Irene Dodgshun, a clerk, on 18 February at the Presbyterian Church, Surrey Hills. During the next seven years, under Upton's guidance, the board organized the design and construction of a State-wide system of roads. On 22 March 1932 Premier **Jack Lang** abolished the board. During the remainder of that year Upton was retained by the Department of Transport in an advisory capacity, and as a member of a committee inquiring into motor omnibus transport in Sydney and Newcastle. Late in 1932 the new premier, **(Sir) Bertram Stevens**, created the Department of Main Roads. Upton was gazetted assistant commissioner.

On 30 April 1935 Upton was transferred to the Metropolitan Water, Sewerage and Drainage Board as president. Although the Depression had begun to ease, an eight-year drought was to accentuate the board's problems. Under Upton's direction, the board was well on the way to

eliminating a backlog of works when World War II broke out. Thereafter, many of its design and construction resources were diverted to the war effort. The largest of these works was the **Captain Cook** Graving Dock at Garden Island for the Royal Australian Navy. After 1945 the water board reverted to its statutory responsibilities. Its major task—to augment Sydney's water supply—was effected by the construction of Warragamba Dam on the Nepean River, which was progressing satisfactorily when Upton retired in April 1955.

A founding associate (1919) and member (1922) of the Institution of Engineers, Australia, Upton joined its board of examiners in 1932. Representing (1939-54) the Sydney division on the council, he was elected a vice-president in 1944 and president in 1946. He chaired (1948-56) the Standards Association of Australia. Upton was awarded the Kernot and (Sir) Peter Nicol Russell medals, respectively by the University of Melbourne in 1947 and by the I.E.A. in 1949. The University of Western Australia conferred on him an honorary doctorate of engineering in 1949.

Maurice William Mehaffey, BE AMICE Assistant Commonwealth Director-General of Works , Deputy Director of Allied Works and Chief of the Dock Construction Section. Responsible for the construction of the graving dock since its inception.



Maurice William Mehaffey (1884-1970), engineer and public servant, was born on 17 December 1884 at Invercargill, New Zealand, son of William Graham Mehaffey, teacher, and his wife Violet Ann, née Mitchell. He was educated at Southland Boys' High School and Canterbury College, University of New Zealand (B.E. (Mech), 1910). He combined his studies with tennis and football and executive positions in student associations. In 1909-10 he lectured in engineering at Canterbury College, then joined the Auckland Harbour Board as assistant engineer.

In 1911 Mehaffey was appointed to the Queensland Railways, and was involved in the design of bridges. In 1912 he took up a position with the Queensland Harbour and Rivers Department and in 1914 was resident engineer at Bowen where he designed and constructed harbour and wharf extensions. In March 1916 he enlisted in the Australian Imperial Force, but after 300 days service he was discharged on the application of the Commonwealth government to permit his appointment to the Commonwealth Lighthouse Service as district lighthouse engineer, Queensland. On 3 July 1917 he married Alma Frances Le Neven in Cairns Presbyterian church. Between 1917 and 1923 Mehaffey supervised the construction of more than twenty lighthouses along the Queensland coast.

In 1923 he became assistant lighthouse engineer at the Melbourne headquarters. As an authority on harbour engineering and the Australian coastline, Mehaffey was twice seconded in 1924 and 1925 to the Prime Minister's Department to advise on national harbour projects. In 1927 he was appointed lighthouse engineer and in 1931-36 was director of lighthouses. His attendance at an international conference on signalling in Paris in 1933 resulted in the programme he initiated for the electrification of Australia's major lighthouses.

In 1936 Mehaffey was appointed Commonwealth director-general of works, and in January-April 1939 was acting director-general of civil aviation. In 1938 he had been responsible for the £400,000 extension of the General Post Office, Sydney. Political agitation led in 1939 to a royal commission into the 'almost fantastically complicated' circumstances relating to the largest Federal public works contract since the Depression. The commission found Mehaffey guilty of serious errors of administration, but not of improper motives. A departmental inquiry reprimanded him and he was transferred to Sydney as assistant director-general of works. From 1940 he was responsible for the construction of the **Captain Cook** graving dock which was so important in the maintenance of naval shipping during the Pacific War. He retired in December 1949.

Mehaffey was an associate member of the Institution of Civil Engineers, London. He died on 25 July 1970 in a private hospital at Turramurra, Sydney, and was cremated. Two sons and a daughter survived him.

Sir William Hudson B Sc. (Eng)



Sir William Hudson (1896-1978), civil engineer, was born on 27 April 1896 at East Nelson, New Zealand, seventh of eleven children of James Hudson, a medical practitioner from London, and his New Zealand-born wife Beatrice Jane, née Andrew. Dr Hudson kept a tight rein on his family and expected Bill to study medicine. Bill enraged him when, in his matriculation year at Nelson College, he said that he wanted to be a civil engineer. In a classic case of parental misjudgement, the father told the son destined to become a world leader in his profession, 'Bill, that is about all you are bloody well good for'.

In 1914 Hudson left New Zealand to enter University College, University of London. A brilliant student, he won the Archibald Head medal, gained the college diploma with distinction and in 1920 graduated B.Sc.(Eng.) with first-class honours. His studies had been interrupted by service in World War I. A second lieutenant in the London Regiment, he was wounded in the thigh at Bullecourt, France, in April 1917. He emerged from hospital with a slight limp in his right leg, a limp which only became pronounced when he was tired. To further his interest in hydro-electric engineering, he took a postgraduate course at the University of Grenoble, France.

Hudson's first job was with Sir W. G. Armstrong, Whitworth & Co. Ltd, London, but he returned to New Zealand in 1922 to join the Public Works Department as an assistant-engineer. He was initially

employed on railway construction and then on the Mangahao hydro-electric scheme. Between 1924 and 1927 he again worked with Armstrong, Whitworth as engineer-in-charge of construction of the Arapuni Dam. At St Columba's Presbyterian Church, Fairlie, on 28 December 1926 he married 21-year-old Annie Eileen Trotter.

In 1928 Hudson crossed the Tasman to work first for the New South Wales Department of Public Works and then for the Sydney Metropolitan Water, Sewerage and Drainage Board. Appointed an assistant-engineer, he later took charge of construction of the Nepean Dam. In 1931 the Depression abruptly halted the project and he found himself unemployed. 'Not a man to remain idle', he moved his family to New Zealand and set off to try his luck in Britain. He was instantly rewarded. Sir Alexander Gibb & Partners offered him the post of engineer-in-charge of construction on the Galloway hydro-electric scheme in a remote corner of south-west Scotland. The largest project of its kind in Britain, the undertaking was challenging and presented, albeit on a minor scale, some of the problems he was to face in the Snowy Mountains of Australia.

Returning to Sydney in 1937, Hudson was again recruited by the Sydney Metropolitan Water, Sewerage and Drainage Board (MWS&DB) as resident engineer for the Woronora Dam project.

In 1940 MWS&DB was appointed to construct the Captain Cook Graving Dock and he was appointed as site engineer. He renewed his association with his previous employer Sir Alexander Gibb & Partners since they were the designer of the dry dock. The dry dock was the largest engineering feat ever attempted in Australia and its successful completion in March 1945 was in no small part due to his efforts. (not included in Australian Dictionary of Biography)

By 1948 he was the board's engineer-in-chief. In the following year he applied for the post of commissioner of the newly established Snowy Mountains Hydro-electric Authority. Nelson Lemmon, the Federal minister for works and housing, was attracted by Hudson's reputation for building dams on time and at fixed prices, and by the opinion of union officials that, although a 'bit of a slavedriver', Hudson was decisive and fair. When cabinet demanded the usual three nominations, Lemmon handed Prime Minister **J. B. Chifley** a slip of paper which read 'Hudson, Hudson, Hudson'.

Appointed on 1 August 1949, at 53 he reached the pinnacle of his career as manager of the Snowy Mountains scheme, responsible for the biggest civil engineering project ever undertaken in Australia and one which the American Society of Civil Engineers would call an engineering wonder of the world.

Ultimately, the workforce (which peaked at 7300 in 1959) built 16 dams, 7 power stations, 50 miles (80 km) of aqueducts and 90 miles (145 km) of tunnels. Completed in 1974, ahead of schedule, and at a cost close to the 1953-54 estimate of £422 million, the scheme had a generating capacity of 3.74 million kilowatts of hydro-electric power and provided an annual average of 2.36 million megalitres of water for irrigation and other purposes.

He was head of the Snowy scheme from 1949 until 1967.

To head this vast undertaking, Hudson was the ideal man. While reserved and even shy, he was driven by ambition, and knew how to choose men, how to inspire and how to lead them. Of middle height, lean and sharp featured, he had a full mouth, a prominent nose, bushy eyebrows and alert, steely eyes. He shouldered the responsibility with a crusading zeal which left no doubt that he saw it as the opportunity for which he had waited and prepared all his life.

Engineers and technical staff were in short supply in 1949. Hudson began at once to 'search the world' for skilled workers and found numbers of them in refugee camps in Europe. Two-thirds of all Snowy personnel were to come from overseas. The S.M.H.E.A. employed people of thirty-two nationalities on the job, some of whom had fought against each other in World War II. Hudson imbued them with an *esprit de corps* by extolling the overriding importance of the project—'You aren't any longer Czechs or Germans, you are men of the Snowy'. He won their respect by taking practical measures for their well-being, by ensuring that they had good pay, food and quarters, by providing housing for their families and by showing concern for their safety. To stir their pride and sense of camaraderie, he kept them informed, published a staff magazine and even promoted a song, *Snowy River Roll*. Alive to the problems likely to arise with an isolated army of men cut off from normal life, he encouraged sporting activity and camp concerts, and allowed wet canteens.

He was head of the Snowy scheme from 1949 until 1967.

Sir William Dobell



Sir William (Bill) Dobell OBE (24 September 1899 – 13 May 1970) was a renowned Australian portrait and landscape artist of the 20th century. Dobell won the Archibald Prize, Australia's premier award for portrait artists on three occasions.

In 1943, under the directorship of the elder Frank Packer, the Allied Works Council (AWC) commissioned two artists working with its manpower agency, the Civil Constructional Corps (CCC), to record the activities of the AWC.

The artists **William Dobell** and Herbert McClintock had been conscripted into the CCC and were working as camouflage artists at the Rathmines sea plane base on Lake Macquarie.

William Dobell visited the aerodromes at Bankstown and Rathmines, Garden Island (Western Australia), Kalgoorlie, Perth and the Sydney graving dock during his commission.

These works were later presented by the Allied Works Council to the Australian War Memorial.



AUSTRALIAN WAR MEMORIAL

ART30249

A cement worker engaged on construction of graving dock, Sydney. Dobell worked for the Civil Constructional Corps when he painted this work.



AUSTRALIAN WAR MEMORIAL

ART30250

Unidentified concrete consolidation worker engaged on construction of a graving dock in Sydney. Dobell was working for the Civil Constructional Corps when he painted this work.

Herbert McClintock



McClintock was born in Perth, Western Australia. He studied at the National Gallery of Victoria Art School from 1925 to 1927 and again in 1930, where he met fellow social realists Noel Counihan and Roy Dalgarno. While a student, McClintock earned a living as a signwriter and advertising artist. He joined the Communist Party of Australia during the depression of the 1930s and did many political cartoons for communist publications. His cartoons were featured in trade union and communist papers throughout his life.

Herbert McClintock had been conscripted into the Civil Constructional Corps (CCC) and was working as a camouflage artists at the Rathmines sea plane base on Lake Macquarie. In 1943, under the directorship of the elder Frank Packer, the Allied Works Council (AWC) commissioned two artists, William Dobell and himself to record the activities of the AWC.



AUSTRALIAN WAR MEMORIAL

ART30253

In this work the focus is placed on the immensity of the structure being built. The scale of the enterprise is emphasised by the towering walls, gantry cranes and a section of pipe being hoisted high above the workers. Herbert McClintock places the viewer in the centre of the building site, with the detail of the far end of the dock lost in the distance, implying that this massive place extends beyond the picture surface. Although there are hundreds of people at work, except for the foreground figures, they are suggested rather than explicitly depicted. McClintock's brand of social realism is one that celebrates the heroism of labour, and the vital harmony needed between workers to successfully complete their sometimes daunting tasks.



Sections of buoyancy tank and floating caissons, Sydney graving dock . ART30254

Working for the Civil Constructional Corps, McClintock was part of manpower initiatives to provide a labour force for the large civil engineering projects across Australia that were necessary for the defence of the country. Even before the war his interest in non-representational art waned and he started to view his subjects from a political perspective. The war provided him with subjects he could sketch in the field and complete in his studio. His social-realist paintings celebrate the achievements of men working on these large technological projects.



AUSTRALIAN WAR MEMORIAL

ART30255

Scene at a graving dock in Sydney. There are two workers in the foreground guiding the lifting of a cement block. Other workers perform tasks such as concrete drilling and the two levels above. McClintock utilises social realism as a means to facilitate the viewer's appreciation of the co-operation between workers, as well as the heroic nature of their work.



AUSTRALIAN WAR MEMORIAL

ART 30256

Four cement workers at Sydney graving dock carrying out heavy manual work working using equipment such as shovels. Cranes and ladders and building structures fill the background. McClintock's focus on the immensity of these structures is demonstrative of the scale of the project being undertaken. The artist also utilises social realism as a means to facilitate the viewer's appreciation of the co-operation between workers.



AUSTRALIAN WAR MEMORIAL

ART30257

Scene of four men working to erect power lines at Sydney Graving. In the background below a group of work around a crane. The four men in the foreground are exerting a large amount of energy though pulling on a thick rope. The artist utilises social realism as a means to facilitate the viewer's appreciation of the co-operation between workers and heroism of their actions.



AUSTRALIAN WAR MEMORIAL

ART30258

Foreground depicts two men shoveling cement at Sydney Graving Dock. The main concrete mixing plant occupies the background. McClintock's focus on the immensity of these structures is demonstrative of the scale of the project being undertaken. The artist also utilises social realism as a means to facilitate the viewer's appreciation of the co-operation between workers.

5.3 Creative or Technical Achievement

The building of the Captain Cook Dry Dock would be the greatest engineering feat in Australia's history, surpassing even the Sydney Harbour Bridge. It would involve the reclamation of 30 acres between Potts Point and Garden Island and the construction of the graving dock 1,139 feet 5 inches (347.29 metres) long, 147 feet 7.5 inches (45 metres) wide and with 45 feet (13.72 metres) draught of water on sill at spring tide.

The full detailed technical explanation for the dock construction are to be found in four papers presented to the Institution of Engineers, Australia in the years 1947, 1951 and in 1952.

John Guthrie Brown M.I.C.E. Sir Alexander Gibb and Partners, *Captain Cook Graving Dock, Sydney*. Paper No. 947 The Journal, April, 1947. The Institution of Engineers, Australia and as Paper No.5585 of The Institution of Civil Engineers presented before the Institution in London on 29th April 1947.

M.W.Mehaffey, BE (NZ). *Captain Cook Graving Dock, Sydney – General Story of Construction*. The Journal, December, 1951. The Institution of Engineers, Australia.

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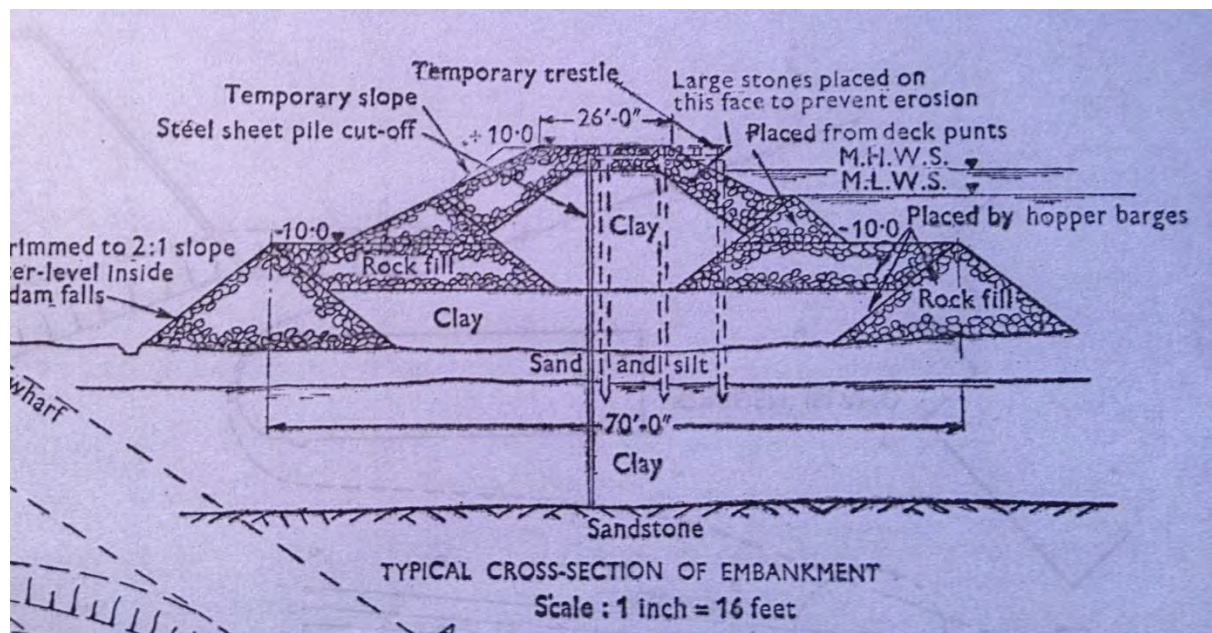
C.R. Bickford. *Captain Cook Graving Dock, Sydney – Fitting-out Wharf of Reinforced Concrete, 250-ton Crane Foundations, and Docking Blocks*. The Journal, March, 1952. The Institution of Engineers, Australia

W. Hudson, B.Sc.(Eng) and D.G.Bruce. *Captain Cook Graving Dock, Sydney – De-watering, Excavations, Concrete Work and Backfilling*. The Journal, March, 1952. The Institution of Engineers, Australia

Summary

Before the work on the dock could begin, the first task was to reclaim the area between Potts Point and the southern tip of the island. Soundings taken over the area indicated that the sea bed was only 25-30 feet below mean low water springs, making some excavation necessary. Two hundred, three inch test bores taken by a diamond drill were examined which disclosed that below a layer of about five feet of silt, there was a firm foundation of sandstone.

One hundred and seventy thousand feet of sheet piling and approximately 800,000 cubic yards of stone and core filling were used to form a huge coffer-dam from which the sea was pumped, leaving a large basin in which the dock would be built.



Sheet piling and placing selected rock against the sheet piling.



The coffer-dam, known as the '*Burma Road*', was commenced in December 1940 and completed early in February 1942.

The fall of Singapore to the invading Japanese on 15 February 1942 added to the urgency of the work. The dock at Singapore was now unavailable and Cockatoo Island was engaged in the construction of new ships for the Navy.

Work on the graving dock continued night and day, with additional labour being hired as the project progressed.

While the embankment was being erected, the silt overlying the area on which the concrete body of the dock was to be established was removed by dredging.

To provide material for the coffer-dam, the New South Wales Department of Public Works opened up a new quarry at Balls Head from which nearly 500,000 cubic yards of sandstone were taken.



Balls Head Quarry - Northern End - 16.2.42

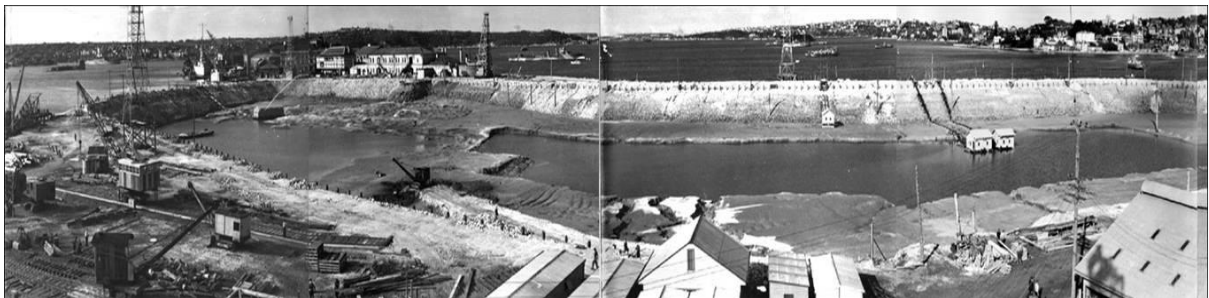


Coffer dam wall



Pumping of the water enclosed by the coffer-dam commenced on 17 February 1942.

Still pumping



Pumping finished. The floor being excavated.



The average workforce was 1,750, rising to a peak of 4,125 in July 1943.



It was an amazing sight, especially at night when the blaze of lights illuminating the work area contrasted with the darkened city.



4
8.4.43

GRAVING DOCK CONSTRUCTION.
General View of Dock, looking North-east.



GRAVING DOCK CONSTRUCTION
GENERAL VIEW OF DOCK LOOKING NORTH



Lighting towers surround the dock.

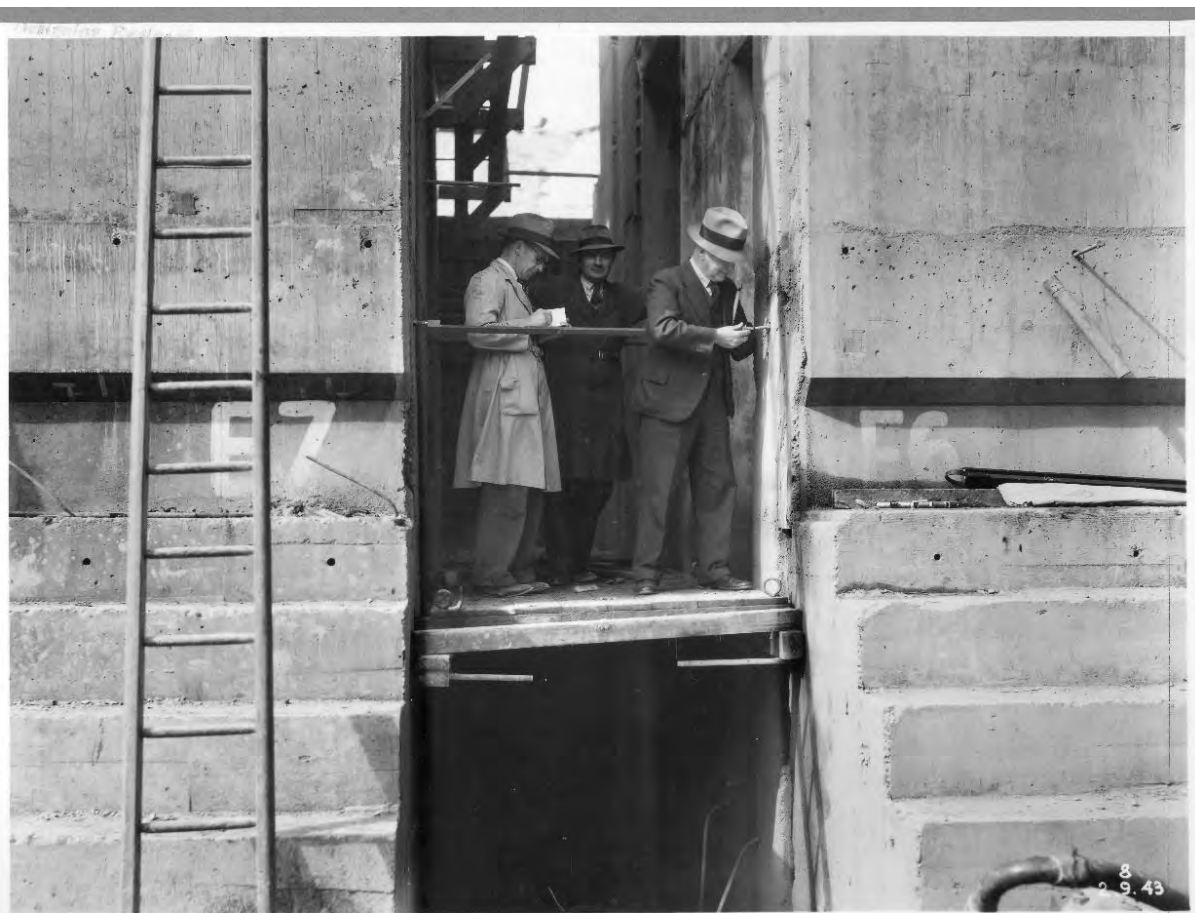
Concrete was poured at a rate of 2,000 cubic yards (1,529 cubic metres) per day. This was special concrete capable of resisting the chemical action of sulphates in the seawater.



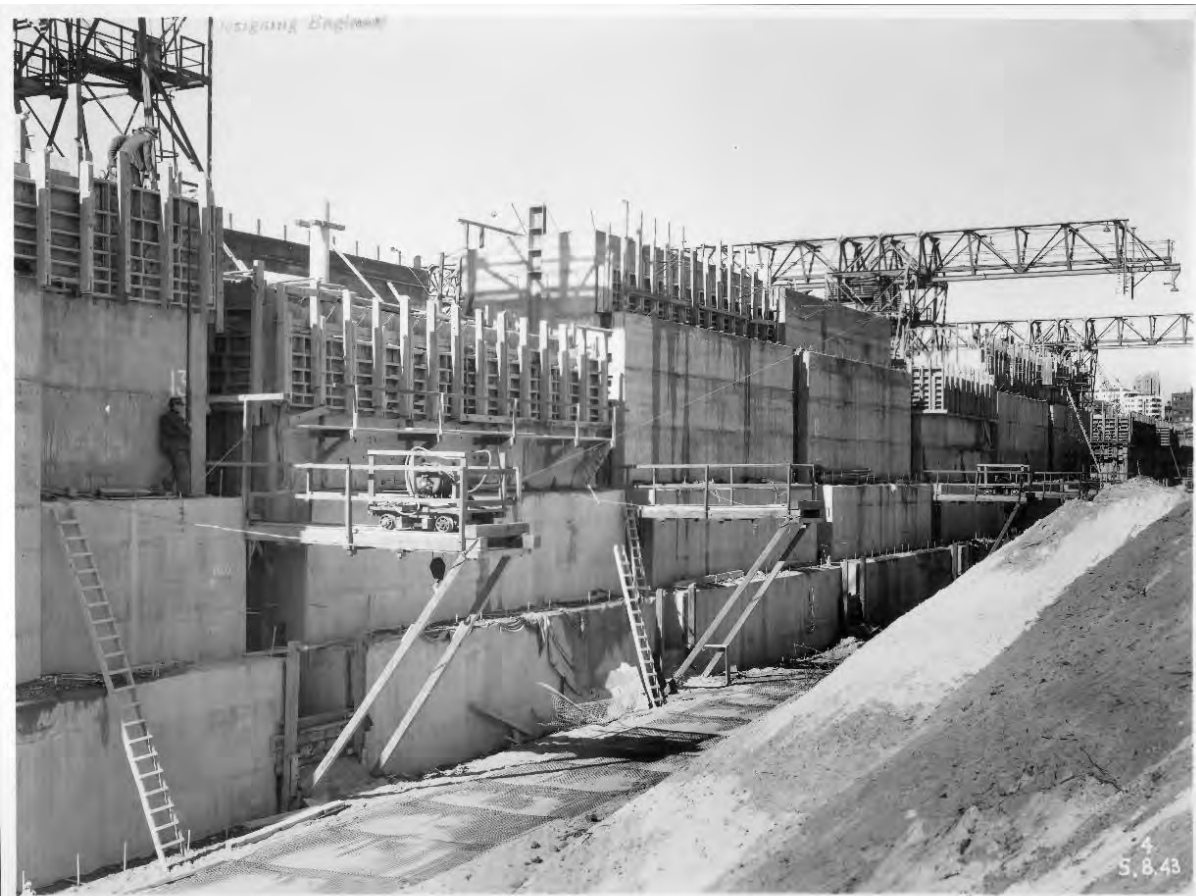
SYDNEY GRAVING DOCK.
Central Mixing Plant.



GRAVING DOCK CONSTRUCTION.
CONCRETE TRANSPORT RAMP FROM MIXING PLANT TO DOCK,
LOOKING NORTH-WEST.



SYDNEY GRAVING DOCK.
MEASUREMENT OF SHRINKAGE OF CONCRETE IN
WALL UNIT BLOCKS.



Sand Filling behind Walls of Dock during concreting of
closing gaps. View of West Wall looking
South ~~EAST~~.



4. GENERAL VIEW OF DOCK LOOKING NORTH-EAST.



ADJUSTMENT OF HOLDING-DOWN BOLTS PRIOR TO
CONCRETING EMERGENCY CAISSON GROOVE.
VIEW LOOKING NORTH-WEST.

11. 11. 43



SYDNEY GRAVING DOCK.
GENERAL VIEW LOOKING SOUTH.

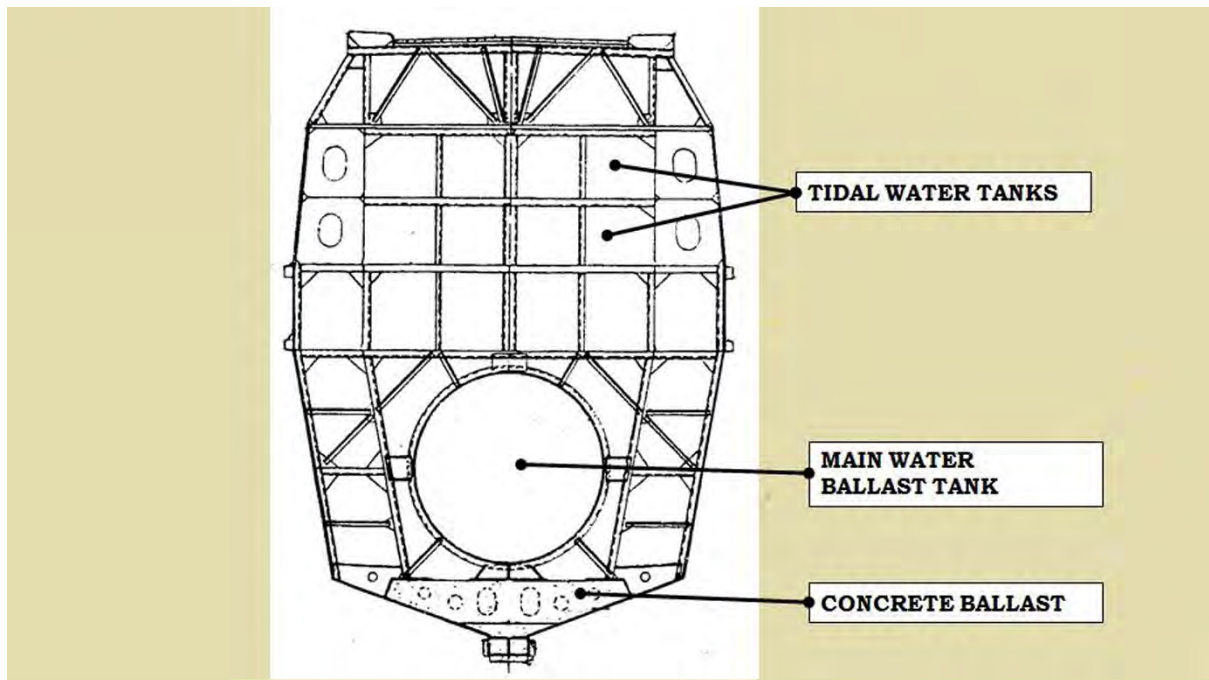


SYDNEY GRAVING DOCK.
Excavation for Entrance Basin to Dock in progress alongside
West Wharf. View looking North-west.



Most of the plant required for the dockyard was manufactured in Britain and shipped to Australia. This was a risky undertaking, given the possibility of attack from German U-boats, bombers and Japanese submarines during the long voyage, but fortunately only two shipments were lost through enemy action.

While the dock itself was being constructed, the caissons, designed by Vickers Armstrong of Barrow-in-Furness were also being built within the area enclosed by the coffer-dam, there being no suitable launching facilities available. Their construction, by the Sydney Steel Company Pty. Ltd., was one of the most difficult undertaken in Australia up till that time; the caissons, made of welded steel, were fitted with buoyancy tanks, tidal chambers and ballast tanks designed to enable their flotation and sinking within the dock grooves as required.



Sections of buoyancy tank and floating caissons, Sydney graving dock . ART30254

Herbert McClintock



CONSTRUCTION OF CAISSONS ADJACENT TO EAST WHARF BY SYDNEY
STEEL CO: VIEW LOOKING SOUTH EAST.



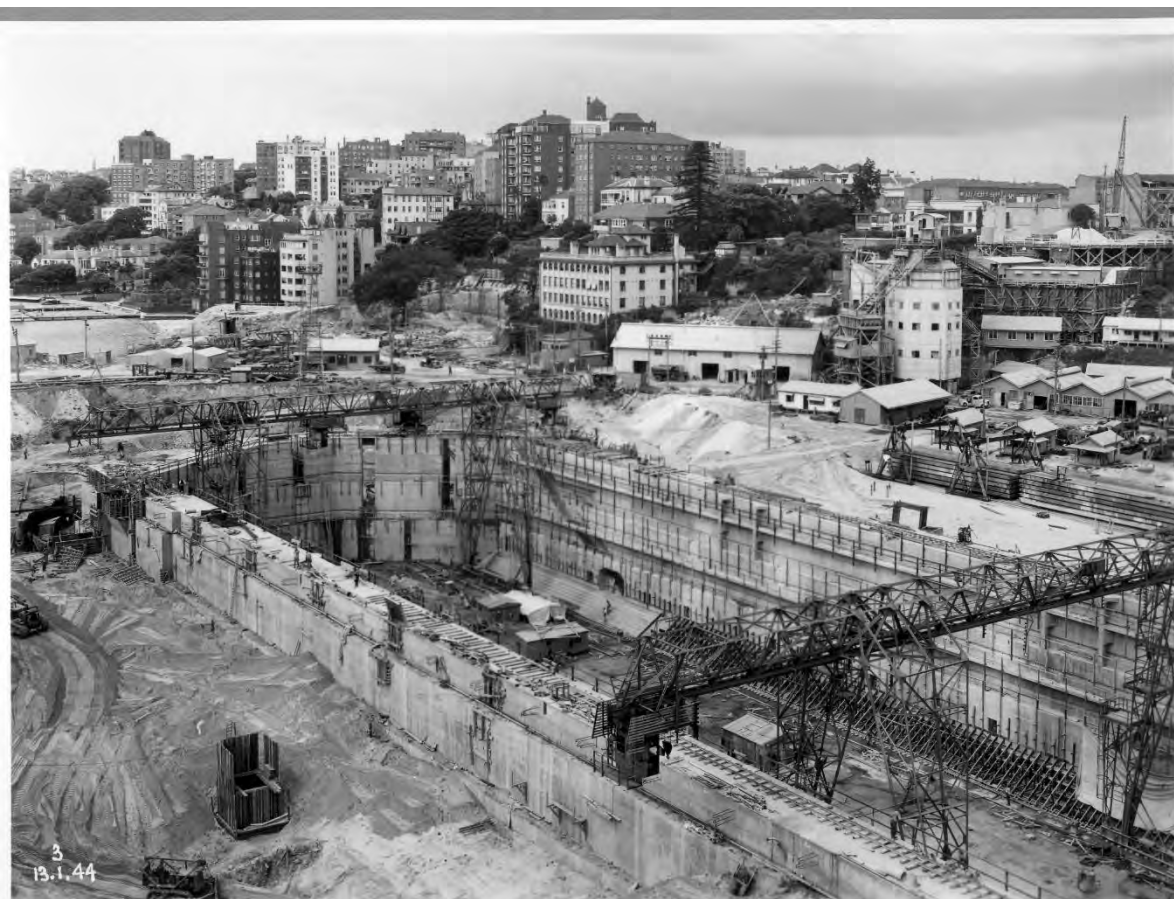
SYDNEY GRAVING DOCK.
CONSTRUCTION OF CAISSONS ALONGSIDE EAST WHARF.



SYDNEY GRAVING DOCK.
Caisson completed sufficiently for floating during
flooding of Dock.



SYDNEY GRAVING DOCK.
View of Dock basin looking south-east, showing assembly
of middle and outline blocks.

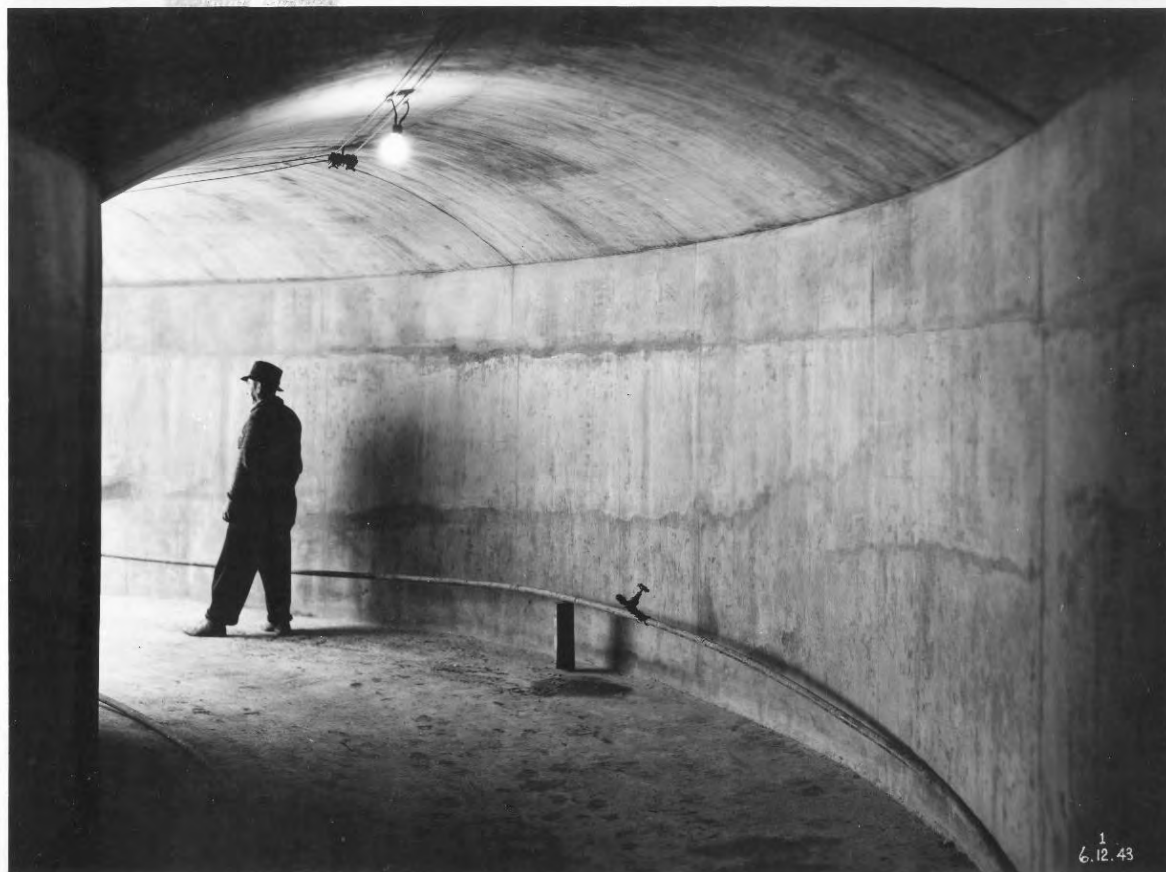


SYDNEY GRAVING DOCK.
VIEW OF SOUTH END OF DOCK LOOKING SOUTH-WEST.



SYDNEY GRAVING DOCK.
VIEW OF ENTRANCE END OF DOCK, LOOKING NORTH, SHOWING
PROGRESS OF FILLING BEHIND DOCK WALLS.

Three 60-inch centrifugal pumps designed to discharge 70,500 gallons (320,493 litres) per minute allowed the dock to be emptied of its 57,000,000 gallons (259,122,000 litres) of water in about four hours.



No.1. FILLING CULVERT IN WEST WALL NEAR OUTLET TO SUMP
SOUTH OF INTERMEDIATE CAISSON GROOVE.



SYDNEY GRAVING DOCK.
INTERIOR OF PUMP HOUSE LOOKING WEST, SHOWING PROCESS IN
ERECTION OF PUMPING PLANT.



The dock was ready for initial flooding in September 1944.

The construction was sufficiently advanced to allow the emergency docking of HMS *Illustrious* on 2 March, 1945, three weeks before the official opening ceremony.



The graving dock was named in honour of Captain James Cook, R.N and opened by the Governor-General, the Duke of Gloucester, on 24 March 1945. To mark the occasion the bow of the River Class frigate, HMAS *Lachlan*, broke a ribbon extended across the entrance to the Dock.

5.4 Research Potential

In advance of the 75th Anniversary of the Opening of the CCD, research was undertaken into four specific areas

- Air Raid Protection for workers by way of tunnels under Garden Island (Paper presented to Australian Tunnelling Society June 2019)
- Balls Head Quarry - To supply sandstone for the coffer dam (Paper presented to Quarry Institute August 2019)
- War artists that were assigned to record the construction and locating paintings –William Dobell ; Herbert McClintock; Henry Hanke; Tony Rafty; Curtis R Emerson; John Goodchild ;J Richard Ashton.
- Cement and concrete operations

Following this initial research the areas that remain to be researched include:-

- Japanese use of the lighting towers at Garden Island in assisting their reconnaissance of Sydney Harbour prior to the attack by midget submarines on 31st May 1942
- Air Raid Protection for workers by way of tunnels under Potts Point
- Health and safety of Civil Constructional Corps workers in the construction of the dock (deaths, disablements and injuries)
- Social impacts on workers conscripted into the Civil Constructional Corps to work on the Graving Dock
- War artists that were assigned to record the construction and locating paintings – To find the location/image of drawings and paintings that are not currently known – in particular

for:- William Dobell -drawings; Henry Hanke – paintings; Tony Rafty – paintings/drawings;
Curtis R Emerson- paintings/drawings; John Goodchild – painting/drawings; J Richard
Ashton- paintings/drawings

- Changes to dry dock pumping systems

The Naval Historical Society of Australia is looking forward to offering a paper on The Garden Island Defence Complex to the Australasian Engineering Heritage Conference 2020 - *'Engineering in a 2020 World – The Future of the Past'* that is to be held in Dunedin NZ 19-25 November 2020.

5.5 Social

One of the major problems faced in the building of the Graving Dock was the lack of labour.

Since the beginning of the war in 1939 the need for troops as well as those in protected professions created problems for required construction workforce to work on defence related projects.

The **Civil Constructional Corps** (CCC) was established in April 1942 to supply labour for the creation of infrastructure like airfields, gun emplacements, barracks, roads and other projects undertaken by the Allied Works Council.

All men between the ages of 18 and 60 could be conscripted into the CCC unless they were serving in the armed forces or employed in a reserved occupation. They received pay based on civilian award rates but their work was highly regulated: they could not strike and might be sent anywhere in Australia.

At its peak strength in August 1943, almost 54,000 men were serving in the CCC. They were involved in hundreds of projects worth millions of pounds. Almost one-third of them were conscripted – or “manpowered”, the term current at the time. By the end of the war 77,500 men had served in the CCC. They had served in every state and territory and made an invaluable contribution to the war effort. Two hundred and eighteen members of the CCC died while serving in it.

Labour employed on the Graving Dock was

January 1941 - 93

July 1941 – 153

January 1942 – 372

July 1942 – 1,588 (1,263 from CCC)

January 1943 – 2,405 (2,063 from CCC)

July 1943 – 4,125 (3,663 from CCC)

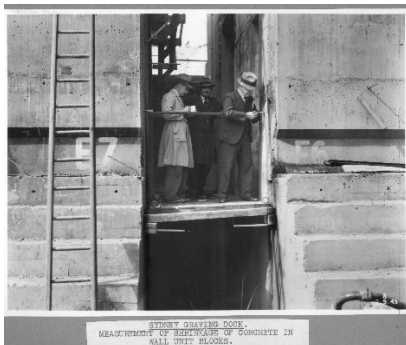
January 1944 – 3,098 (2,562 from CCC)

July 1944 – 2,157(1,056 from CCC)

January 1945 – 1,761 (1,123 from CCC)



While the workers on the construction included engineers, surveyors, tunnellers, shotfirers, electricians, plant operators, metal workers, carpenters as well as experienced construction and excavation foremen the bulk of the workers were untrained in the work that was required of them.



Engineers



Surveyors



Steam shovel operators



Bulldozer operator



Carpenters

The untrained men from the CCC became involved in rock, steel and concrete placement and if they were lucky became truck drivers. The shovel, wheel barrow and their hands were their tools of their trade.



The ubiquitous man with a wheelbarrow



Tunnellers pushing loaded wagons



Labourers drilling holes for blasting as well as shovelling rock into wagons



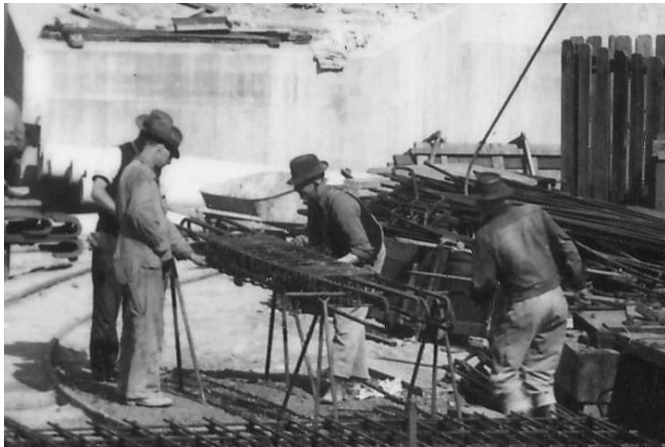
Placing 80,000 tons of selected rock into the coffer dam by hand. 30 September 1941



Concrete gangs using vibrators for consolidation



Concrete gang



Steel reinforcement gang



Truck drivers

5.6 Rarity

While the CCD is the largest dry dock in Australia there are similar docks of same or slightly larger dimensions in South Africa and in Singapore.

5.7 Representativeness

The CCD is representative of the style of dock required to accommodate large vessels, both naval and in commercial shipping

5.8 Integrity/Intactness

The CCD remains intact with only minor alterations while all of its original pumping equipment and caissons remain in operation today.

The original services (sea water, fresh water, demineralized water, compressed air, steam and power) supplying the dock and adjacent wharves, contained within the service tunnels around the dock, were upgraded/replaced in late 1970's early 1980's. A new program to replace/upgrade services commenced in 2019 and is due for completion in two years.

The original tunnels and service ducts are to be utilized.

5.9 Statement of Significance

The CCD is a National Asset continuing to service the Royal Australian Navy and commercial vessels of Australia and New Zealand. The engineering achievement in building the CCD at time of war underlines its significance as one of Australia's major engineering achievements that provided the basis for further great engineering works and in particular the Snowy Mountains Scheme.

5.10 Area of Significance

The construction of the CCD demonstrated the ability for multiple engineering capabilities to be brought together in Australia to achieve a world class engineering outcome.

6 INTERPRETATION PLAN

While the Engineering Heritage National Recognition Plaque could be near the Opening Plaque at the Dock Office adjacent to the CCD, the interpretation panel should be located adjacent to the main gate to the Garden Island Defence Precinct.

The Interpretation Plan should show the various steps from Garden island separated from the shore, coffer dam construction, dock

7 REFERENCES

Australian Dictionary of Biography

Photographic record of the construction of the Captain Cook Graving Dock including the Balls Head Quarry – George Hicks Photograph Collection - Archives of the Naval Historical Society of Australia

The Story of the Graving Dock , Sydney Australia – Official souvenir for the inauguration of the Graving Dock, Sydney March 24 1945 by His Royal Highness, The Governor- General, The Duke of Gloucester KG PC KT KP GCB GCMG GCVO LL D accompanied by Her Royal Highness The Duchess of Gloucester - published by the Director- General of Works

John Guthrie Brown M.I.C.E. Sir Alexander Gibb and Partners, *Captain Cook Graving Dock, Sydney*. Paper No. 947 The Journal, April, 1947. The Institution of Engineers, Australia and as Paper No.5585 of The Institution of Civil Engineers presented before the Institution in London on 29th April 1947.

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W. Hudson, B.Sc.(Eng) and D.G.Bruce. *Captain Cook Graving Dock, Sydney – De-watering, Excavations, Concrete Work and Backfilling*. The Journal, March, 1952. The Institution of Engineers, Australia

History of The Captain Cook Graving Dock – DVD Produced by Naval Historical Society of Australia

Garden Island Historical Tours - DVD Produced by Naval Historical Society of Australia

History of the 250Ton Hammerhead Crane - DVD Produced by Naval Historical Society of Australia

Garden Island – The Tunnels complex under the Hill - Presentation to Australian Tunnelling Society 19th June 2019, Colin Randall , Naval Historical Society of Australia

Balls Head Quarry - Presentation to the Quarry Institute of Australia, Sydney Branch, 14th August 2019, By Colin Randall BE(Mining) FAusIMM (CPRtr), The Naval Historical Society of Australia

60th Anniversary of Captain Cook Graving Dock - Naval Historical Society – March 30, 2005

Heritage dock delivers for future fleet- Navy Daily – December 8 2017

War Artists – Proposed art exhibition to celebrate 75th Anniversary of the Opening of the Captain Cook Graving Dock - Colin Randall September 2019

Captain Cook Dry Dock - Construction in Concrete - Proposed Presentation to Concrete Institute of Australia- Colin Randall August 2019

8 ACKNOWLEDGEMENTS, AUTHORSHIP AND GENERAL NOTES

8.1 Acknowledgements

Over the last 50 years the Naval Historical Society of Australia has fostered and nurtured the study of the history of the Royal Australian Navy and its shore establishments. Garden Island has been central to the story of the RAN and the archives collected bring the history of the building of the Captain Cook Graving dock into sharp relief. Society volunteers who over the years have collected, maintained and added to these archives over the years include Norm Rivett , George Hicks and David Stockman.

The nomination proposal has been reviewed and refined by members of the Committee.

The assistance of present and past members of the Society in enabling this Nomination are acknowledged.

8.2 Nomination Preparation

This nomination was prepared by:

Colin Randall BE (Mining) FAusIMM, (CP) Rtr

Volunteer Researcher

Naval Historical Society of Australia

7.3 General Notes

9 CHANGE CONTROL BLOCK

APPENDICES

Appendix 1

PROFORMA NOMINATION FOR ENGINEERING RECOGNITION

APPENDIX B: Proforma - Proposal to Nominate for Engineering Heritage Recognition

Name: Other/Former Names: Captain Cook Graving Dock

Location: Garden Island, Sydney, New South Wales

Address: Garden Island Defence Precinct

Map: Sydney Harbour

Nominated by: The Naval Historical Society of Australia

Contact: Colin Randall, Committee Member

EHA Group: Unknown

Significance: National

Current Owner: Commonwealth of Australia

Current use: Dry dock

Former use: Dry Dock

Proposed use: Dry Dock

Owner/Client: Commonwealth of Australia

Designer: Sir Alexander Gibbs and Partners and Mr Guthrie Brown

Builder: The Metropolitan Water Sewerage and Drainage Board under its President Thomas Haynes Upton. Upton was a founding associate (1919) and member (1922) of the Institution of Engineers, Australia, Upton joined its board of examiners in 1932. Representing (1939-54) the Sydney division on the council, he was elected a vice-president in 1944 and president in 1946.

Started: 1940

Completed: 1945

History: The need for a naval graving dock in Australia became crucial with the deteriorating world situation in the 1930s. There was little doubt that Australia's security would depend upon its commercial sea lanes. The country's ability to maintain the rate at which its naval forces could be repaired and returned to sea would play a large part in its ultimate survival.

In 1938 the Cabinet responded to this situation by approving, in principle, the construction of an Australian naval graving dock. The Australian Government approached the British Admiralty with its assessment of the requirement and asked for its assistance. As a result Sir Leopold Savile KCB, a senior principal in the British engineering firm Sir Alexander Gibb and Partners, was invited to Australia to investigate and report on the most suitable site. As a former Civil Engineer- in-Chief of the British Admiralty and responsible for the Singapore Naval Base, Savile was eminently qualified

for the task. He arrived in June 1939 for a tour of every state and an inspection of 16 possible sites located within eight principal ports in southern Australia. He was to consider the strategic as well as the engineering aspects of the sites and was reminded that the dock would also need to be used for repairing large merchantmen acting as troop ships. After completing his investigation, Savile concluded that three sites would fulfil these requirements. One was at Adelaide while the other two were in Sydney Harbour. Construction of the graving dock between Garden Island and the foreshore would best fulfil all the requirements. It was already well protected, provided easy entry for the fleet, and would enhance the importance of the existing Garden Island Naval Depot. In a report dated 31 January 1940, Sir Alexander Gibbs and Partners advised the adoption of the Garden Island-Potts Point proposal.

Parliamentary approval

The Prime Minister, Mr. R. G. Menzies, told the Parliament on 1 May, 1940: *'A dry dock of a larger size than any in Australia has been an important strategic consideration since the size of capital ships has increased so greatly. I do not need to elaborate the great value to Australia of a dock capable of accommodating not only the largest warships but also merchant ships of great tonnage. The possession of such a dock would make Australia a fit base for a powerful fleet and would, in certain contingencies, enable naval operations to be conducted in Australian waters without the necessity for ships to travel 4,000 miles to Singapore for purposes of refit and repair. It is estimated that three years will be occupied in the construction of the dock. The estimated cost of the dock on the selected site is, in Australian currency, £2,997,000 compared with £3,039,000 for the other Sydney site (above the Harbour Bridge), and £3,839,000 for the Adelaide site. The Government has decided to accept the recommendation, and the work will be put in hand at the earliest possible moment.'*

On 4 July 1940 the War Cabinet decided that although the project had been the responsibility of the Department of the Navy, the construction phase should be placed under the Department for the Interior, which established a Dock Construction Section under the Assistant Commonwealth Director-General of Works, W. M. Mehaffey. Close liaison would be maintained with the Admiralty and the firm of consultants, particularly Mr. Guthrie Brown who designed the dock. In addition to the construction of the graving dock, new workshops and modern machinery would be provided on the island, together with construction of a repair wharf with a 250-ton crane.

Coffer dam

This would be the greatest engineering feat in Australia's history, surpassing even the Sydney Harbour Bridge. It would involve the reclamation of 30 acres between Potts Point and Garden Island and the construction of the graving dock 1,139 feet 5 inches (347.29 metres) long, 147 feet 7.5 inches (45 metres) wide and with 45 feet (13.72 metres) draught of water on sill at spring tide.

Before the work on the dock could begin, the first task was to reclaim the area between Potts Point and the southern tip of the island. Soundings taken over the area indicated that the sea bed was only 25-30 feet below mean low water springs, making some excavation necessary. Two hundred, three inch test bores taken by a diamond drill were examined which disclosed that below a layer of about five feet of silt, there was a firm foundation of sandstone. One hundred and seventy thousand feet of sheet piling and approximately 800,000 cubic yards of stone and core filling were used to form a huge coffer-dam from which the sea was pumped, leaving a large basin in which the dock would be built. The coffer-dam, known as the *'Burma Road'*, was commenced in December 1940 and completed early in February 1942. The fall of Singapore to the invading Japanese on 15 February 1942 added to the urgency of the work. The dock at Singapore was now unavailable and Cockatoo

Island was engaged in the construction of new ships for the Navy. Work on the graving dock continued night and day, with additional labour being hired as the project progressed.

To provide material for the coffer-dam, the New South Wales Department of Public Works opened up a new quarry at Balls Head from which nearly 500,000 cubic yards of sandstone were taken. While the embankment was being erected, the silt overlying the area on which the concrete body of the dock was to be established was removed by dredging. Pumping of the water enclosed by the coffer-dam commenced on 17 February 1942. The average workforce was 1,750, rising to a peak of 4,125 in July 1943. It was an amazing sight, especially at night when the blaze of lights illuminating the work area contrasted with the darkened city.

Special concrete

Concrete was poured at a rate of 2,000 cubic yards (1,529 cubic metres) per day. This was special concrete capable of resisting the chemical action of sulphates in the seawater. Most of the plant required for the dockyard was manufactured in Britain and shipped to Australia. This was a risky undertaking, given the possibility of attack from German U-boats, bombers and Japanese submarines during the long voyage, but fortunately only two shipments were lost through enemy action.

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The dock was ready for initial flooding in September 1944. Three 60-inch centrifugal pumps designed to discharge 70,500 gallons (320,493 litres) per minute allowed the dock to be emptied of its 57,000,000 gallons (259,122,000 litres) of water in about four hours. The construction was sufficiently advanced to allow the emergency docking of HMS *Illustrious* on 2 March, 1945, three weeks before the official opening ceremony.

The graving dock was named in honour of Captain James Cook, R.N and opened by the Governor-General, the Duke of Gloucester, on 24 March 1945. To mark the occasion the bow of the River Class frigate, HMAS *Lachlan*, broke a ribbon extended across the entrance to the Dock.

Interpretation Themes: None - Operating dry dock

Description: Involved the reclamation of 30 acres between Potts Point and Garden Island and the construction of the graving dock 1,139 feet 5 inches (347.29 metres) long, 147 feet 7.5 inches (45 metres) wide and with 45 feet (13.72 metres) draught of water on sill at spring tide.

Condition: Fully operational

Heritage Listing: Commonwealth Heritage Listed

Heritage Significance: National

Photographs: Provided under separate cover since too numerous

Appendix 2

John Guthrie Brown M.I.C.E. Sir Alexander Gibb and Partners, *Captain Cook Graving Dock, Sydney*. Paper No. 947 The Journal, April, 1947. The Institution of Engineers, Australia and as Paper No.5585 of The Institution of Civil Engineers presented before the Institution in London on 29th April 1947.

Appendix 3

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Appendix 5

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Appendix 6

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